JOSIAH CLARK NOTT, INSECTS, AND YELLOW FEVER

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Facts ... that are before us constantly,
cease to excite reflection ... .
Josiah Nott

BOOKS and review papers on medical entomology or tropical medicine usually offer brief histories of our knowledge of arthropods as vectors of disease. Such thumbnail histories of the transmission of yellow fever or malaria almost invariably cite papers published in 1848 by Josiah Clark Nott (see figure),[1] a physician of Mobile, Alabama, who, some say, first suggested that insects might transmit these diseases. In this paper I intend neither to praise nor to disparage Nott or his opinions, but to set out and to discuss his reasoning and assertions, and to dispel some of the mistaken notions with which others have invested his views.

For purposes of perspective, notice that Nott's 1848 papers[2,3] antedated Pasteur's early work and the germ theory by several decades. The first experimental if indirect evidence of disease transmission by a blood-sucking arthropod would come with Manson's 1878 work on mosquitoes and filariasis,[4] followed in 15 or 20 years by the definitive studies of Smith, Ross, Reed, and others on various arthropod-borne organisms. These classic studies are well known to most entomologists, physicians, and parasitologists. It was not clear to me, however, and perhaps not clear to others in the field, what Nott might have contributed to contemporary thought about insects and disease, especially yellow fever. Because of the historical primacy usually assigned to Nott's views, I undertook to review his original papers.

SOME COMMON PERCEPTIONS OF NOTT'S VIEWS

The first few texts I consulted provided several versions of Nott's

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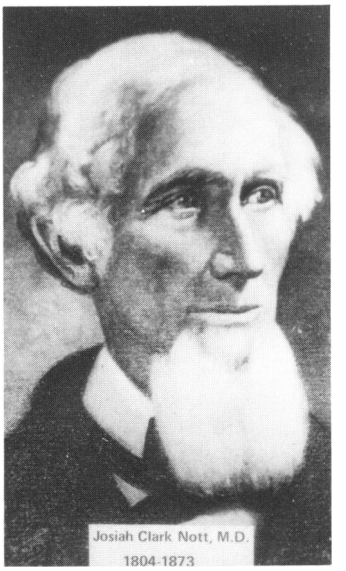

Detail of an oil portrait of Nott, presumably executed from an old photograph. The painting, signed "Maber, 29, Mobile, Alabama," hangs in the Reynolds Historical Library of the Lister Hill Medical Library, University of Alabama School of Medicine, Birmingham, Alabama. I am indebted to the libraries for providing the photograph and for permission to publish it.

contribution. The following quotations will illustrate how his work is commonly perceived:

> In 1848 Dr. Josiah Clark Nott ... published some work on yellow fever, upheld the mosquito origin of transmission and surmised that the mosquito of the lowlands might be the origin of malaria fever. This is the first reference we have been able to discover suggesting any connection between yellow fever and mosquitoes.[5]
>
> Nott ... wrote knowingly of yellow fever in the mid-nineteenth century and related the disease to hematophagous insects, but his commentary was only one among a welter of explanations, and it could not be adequately supported since it was made in advance of the development of the basic theory of causes of disease.[6]
>
> Nott accurately pinpointed the real transmitters of yellow fever, namely mosquitoes.[7]
>
> Josiah Nott of New Orleans [*sic*] postulated that mosquitoes give rise to both malaria and yellow fever, thus advancing the vector concept.[8]
>
> In 1848, Nott of Mobile appears to have stated that both yellow fever and malaria may be transmitted by mosquitoes.[9]
>
> ... [Nott] was the first to suggest that yellow fever was conveyed to human beings by the bite of insects—mosquitoes probably being the agents.[10]
>
> ... [Nott] contended that yellow fever existed in some form of insect life, most

> probably mosquitoes, and implied that the mosquito theory of malaria transmission had already been accepted.[11]
>
> ... [Nott] published his belief that mosquitoes "gave rise to" both malaria and yellow fever.[12]
>
> ... [Nott] was apparently the only Alabama physician before 1850 who subscribed to the theory of insects as a vector.[13]

NOTT ON NOTT

Nott's "Sketch of the epidemic of yellow fever of 1847, in Mobile,"[3] encompasses almost all aspects of the epidemic and of clinical yellow fever. One brief paragraph alludes to insects:[14]

> The disease in Mobile, as well as in New Orleans, commenced early—ran its course and *ceased in the midst of warm weather, long before frost;* thus showing a strong analogy with the habits of insect life. There was no weather to *stop animal and vegetable decomposition.* Many insects, like epidemics, have a limited time allotted them; but vegetable and animal decomposition only cease with [?the end of] hot weather ....

In the same year, Nott[2] published his longer and oft-cited treatise positing that yellow fever is a disease *sui generis* not to be confused with malaria. The emphasis is laid mainly on clinical comparisons of the diseases, but scattered through the densely-written text are Nott's beliefs about the animal causation or propagation of yellow fever. Because these allusions are diffuse and difficult to follow, I have excerpted, in sequence, every nontrivial reference to insects. These extracts provide insights into Nott's views about the presumptive role of insects in yellow fever.

> I now propose to give the results of my observations on the peculiar habits, or what might be called the Natural History of this disease, and my reasons for supposing its specific cause to exist in some form of Insect Life .... There is no novelty in the doctrine of Insect or Animalcular origin of diseases[15] ... but it is only since the publication of Ehrenberg's great work on Infusoria (1838) that its bearing can be fully appreciated. The medical periodicals of late years have made occasional allusions to the subject .... The most elaborate and ingenious article I have met with is that of Sir Henry Holland's ... "On the Hypothesis of Insect Life as a cause of Disease."[16]

Arguing that yellow fever is a disease *sui generis*, Nott asserts that in contradistinction with malaria,

> ... the morbific cause of Yellow Fever is not amenable to any of the laws of gases, vapors, emanations, etc., but has an inherent power of propagation, independent of the motions of the atmosphere, and which accords in many respects with the peculiar habits and instincts of Insects.

After discussing the development and course of several yellow fever epidemics in Mobile, Nott points out that in some years

> .... the disease started in succession from several or many foci, and diffusing itself gradually or rapidly in different years, seemed to lose all connection with the points of departure or origin; cases occurred here and there in every direction ... a little reflection will satisfy the reader that [these facts] are all perfectly reconcilable by the Insect Theory and no other.

To support the "insect theory," Nott turns to the insects of plants, especially to the major pests of cotton, this "little sketch" being sufficient "... to show some striking analogies between the habits of insects and those of certain Epidemic diseases." Nott recognizes certain variations in insect behavior, population density, "dormancies", etc., but the

> ... reasons for their long repose, their irregular and sudden resurrection, their varying numbers, the habitation and condition of their germs during these different periods, are inexplicable difficulties which remind us strongly of the vagaries of Yellow Fever. The different insects, too, (like Epidemic diseases,) attack different *organs* of plants—at one time very circumscribed in their operations, attacking one or a few spots; and at another, bursting forth like a widespread Epidemic. There are no appreciable meteorological changes which can account for "each change of many-colored life."

Noting that effluvia from decaying animal or vegetable matter abound every summer but that the fevers occur only occasionally, Nott continues with his central theme:

> Though my argument is intended particularly to illustrate Yellow Fever, which I regard as a disease *sui generis,* still I may be permitted to remark that the present state of facts do not warrant us in assuming Identity for all the other forms of what are termed Marsh Fevers, viz. Intermittent, Remmitant, Bilious, and Congestive Fevers. The various and strongly contrasted types described in the United States [and in various other countries] may well excite serious doubts on this point. I am by no means sure that all these types may not be most rationally explained by attributing them to various insect species, but laying aside this hypothesis and assuming the *malarial,* it would be a strange anomaly in nature, should it be proven that but one morbific cause of fever is generated over the broad surface of our variously compounded globe.—Fever should have its *genus* and *species,* like other things in nature.

After a considerable digression, Nott elaborates on a point first made in his other 1848 paper:

> ... when yellow fever once gets under way ... nothing short of a "killing frost" can arrest it .... Effluvia would not be affected by a single freezing night ... but not so with the Yellow fever—like in insect life, when the ova are once hatched, the propagation of this disease goes on until arrested by a *killing frost*—and it can only be animated by another summer's sun, which calls from their slumbering places the various insect tribes.

Nott sets out the arguments of several well-known writers on the "transportation" of the various fevers, adding that

> There are numerous instances recorded of vessels lying near the wharfs of infected towns, or near other vessels, on board of which, Yellow Fever prevailed violently, without being contaminated. There are even perfectly authenticated instances where *one side or end* of a ship has suffered severely from this disease, whilst the other was entirely free from it! We can readily believe, that certain insects which are endowed with unaccountable instincts and habits, might attack part of a ship, of a tree, of a wheat or cotton field; but we cannot imagine how a gas could be turned loose on one side of the cabin of a vessel and not extend to the other!!!! Some new law of gases or emanations must be discovered by the Malaria party before they can explain this mystery.

Nott compares the geographic and vertical distributions of malaria and yellow fever, tries to reconcile the widely divergent or contradictory opinions concerning their epidemiology and propagation, and makes two (independent) comments on insects:

> It would certainly be quite as philosophical (as in the Malarial theory) to suppose that some insect or animalcule, hatched in the lowlands, like the mosquito, takes flight ... to fulfill its appointed destiny.
>
> All the attempts heretofore made to account for the greater activity of the morbific cause of Yellow Fever at night have failed, and in my humble opinion the fact may be much better explained by a reference to the habits of Insect Life. Many of the Infusoria, as well as insects proper, are rendered inactive by too much light, heat, or dryness. They remain quiet through the day, and do their work at night. This fact is too familiar to require illustration. The moth tribe, the night mosquitoes, many of the Aphides, etc., are familiar examples.

Six pages later, having explored the behavior of yellow fever in man, in nature, and in its various epidemic manifestations, Nott states that "It was not my plan to argue the Insect origin of Periodic fevers in this paper, but the morbific causes of Fevers have been so long and so inseparably united in the minds of the profession that it is almost impossible to tear them asunder now."

After commenting on "marsh miasmata" and on the physical behavior of "... the *materies morbi,* whatever it may be ...," Nott returns to insects:

> The Insect theory is perhaps as applicable to Periodic as Yellow Fever. We can well understand how insects wafted by the winds (as happens with muosquitoes, flying ants, many of the Aphides, etc.,) should haul up on the first tree, house or other object in their course offering a resting place; but no one can imagine how a gas or emanation, entangled or not with aqueous vapor, while sweeping along on the wings of the wind, could be caught in this way ...

Nott believes that yellow fever is not contagious but sees no conclusive evidence that "... the germ or *materies morbi* may not be transferred from one locality to another." Thus, "The Insect theory here again comes to our aid, and may explain difficulties which have much perplexed

writers on contagion." There is no reason to think, says Nott, that gaseous emanations from damaged vegetable or animal matter could produce yellow fever ...

> We have evidence around us almost constantly that the germs of Insects lie dormant for indefinite periods and are then suddenly called into activity and propagated with inconceivable rapidity. By what physical causes these sleeping and waking states are governed, human sagacity cannot yet divine .... It is probable that Yellow Fever is caused by an insect or animalcule bred on the ground ...

Nott compares yellow fever with truly contagious diseases such as smallpox and their behavior in different times and places, but since

> ... according to the theory we are discussing, the Natural History of Yellow Fever is closely allied to the Natural History of Insects, it is proper that I should say a few more words on the latter. The Infusoria, or Microscopic animalcules particularly demand a passing notice, as few of our readers have access to original sources on this curious subject. It has I think been pretty clearly shown that the propagation of Yellow Fever cannot be explained by the Malarial theory, and it must remain with the reader to determine whether the chain of analogies offered render the Insect theory more probable ... It is to the great work of Ehrenberg that we are more particularly indebted for our greatly augmented and more positive knowledge of Infusoria.[17]
>
> A very faint idea may be conceived of the infinite extent of these minute forms of insect life from the simple fact stated by Ehrenberg, that five hundred millions [*sic*]...may exist in a single drop of water!
>
> The term *Infusoria* has been used as a generic one to embrace all microscopic *animalcula*; there are, however, forms which should not come under this head ... and we have every reason to believe that countless species still exist, too small to be reached by our most powerful microscopes. The infusoria proper, which are found in fluids, are of course more easily seized and examined than those minute microscopic beings that are floating through the air.

Nott recounts that Ehrenberg described 722 species of Infusoria, ubiquitous in the air, various waters, the earth, and among fossils. Counted among the Infusoria are the rotifers and species of aphids (plant lice). Nott quotes from a textbook on entomology:

> The multiplication of these little creatures, i.e., Infusoria is infinite and almost incredible. Providence has endued [?endowed] them with priviledges promoting fecundity, which no other insects possess ... [viviparity, oviparity, sexual reproduction] ... and it is supposed that in one year there may be 20 generations!!!
>
> With these few facts before us, how much more easily may we account for the spread of yellow fever from a locus, by the insect, than by the Malarial hypothesis [of miasms]—here is something tangible and comprehensible.

Nott expands on the knowledge and distribution of Infusoria, even citing the "distinguished naturalist, Chas. Darwin," who, during his

voyage on the *Beagle* collected many Infusoria from the dust that fell far out at sea.

> One of the most highly organized and most interesting in connection with our subject, is the *Rotifer,* (Rotatoria) . . . . [it may remain] in a dry and apparently lifeless state for an indefinite period, and then being again resuscitated by the application of moisture.
>
> Here we have the proof that both the animalcule and its germ may lie dormant, as is the habit of certain diseases, and then be brought into activity when its appropriate stimulus is applied. We have the evidence, too, that they may be transported through the air to a distant point, and there abide their time, as do the fomites which transport contagious diseases. What are the causes, meteorological or other, which call them into action, we are ignorant as we are of those which govern larger insects, as the Aphides, the Hessian Fly, the Cotton Worms, etc. . . .

Nott reminds readers that "We know that certain cutaneous diseases are produced by animalcules—that animalcules and little worms are very often found in the various fluids of the body, as the blood, urine, bile, etc.,—also in the solids, as the brain, liver, eye, etc.," and he gives further examples from authorities. He continues:

> To one living on the Gulf of Mexico, it would look like a waste of time to speak of swarms and migrations of Insects. At the very moment I am writing I am annoyed by gnats, bugs, moths, etc. in such numbers that an inhabitant of a northern latitude could not conceive how I can connect two sentences together, and I confess that sometimes they are so troublesome that I am thinking more of my persecutors than the subject before me. Facts however that are before us constantly, cease to excite reflection . . . .

Several examples of insect behavior, migration, and reproduction of various insects lead Nott to state that "The history of those great epidemics which sweep over the surface of the globe affords very strong support to the Insect theory"—and he cites several examples, including cholera, the latter without explanation. Finally,

> Miasmatic fevers abound in most Southern latitudes; and the reason assigned is the greater amount of vegetable matters which is here subject to rapid decomposition. But it should not be forgotten that here, too, are to be found in great excess the various forms of Insect life, Infusoria, etc., etc.
>
> But it is high time that this long and rambling essay should be brought to a close. No one is more sensible of its imperfections than myself, but were I competent to do ample justice to the numerous topics alluded to, far more extended limits would be required than can here be permitted. The reader need not be told how endless and complicated are the ramifications of the subject of Malaria. I have not attempted to elaborate fully a single point, and my object was simply to attract attention to certain phenomena of yellow fever which I think have been too much overlooked, and to lay before the profession, in connexion

with them, some material which may serve for reflexion.

Curiously enough, in his last two papers on yellow fever,[18,19] one evidently drawn from the other, Nott discusses the epidemiology of the disease at great length but accords insects only slight and almost indifferent notice.

Critical Comments on Nott's Views

According to Nott's "chain of analogies," insects or animalculae (Infusoria), alone or together, somehow contributed to the spread of yellow fever, although "By what means the poison of insects or animalculae might be communicated through the air or directly to individuals, we know not".[20] This self-admitted lacuna, published six years after his "insect" papers, looms large because Nott had already excluded (to his own satisfaction) direct person-to-person spread of yellow fever.

Clearly, mosquitoes held no special place in Nott's thinking, nor did he suggest what role(s), if any, these or other insects might play in propagation or transmission. One comes away with the impression that the mere presence of insects, as animalcules, might somehow be sufficient to produce or spread disease. Furthermore, Nott's views of the Infusoria were often vague, muddied, or inconclusive; nevertheless, it appears he was trying to suggest on "philosophical" grounds an organismic basis for such diseases as yellow fever—an admirable if not novel idea. In sum, except that the words "insect" and "yellow fever" appear on the same pages, I do not find that Nott grasped or foresaw the role of insects in yellow fever any more than had his many predecessors who had speculated about insects and disease. Having reached these conclusions, one must also wonder, in fairness, whether the reader in the 1980s can realistically seek unambiguous meanings and intents from the writer in the 1840s; however, specificity in thought, if not in evidence, cannot be gainsaid even by the Notts of this world.

Other observers have expressed somewhat similar reservations about the significance of Nott's 1848 papers. Their opinions, some most thoughtful and penetrating, warrant rescue from the limbo to which they seem to have been relegated. Thus, Packard,[21] for example, writes that "Unfortunately, [Nott's views] may be regarded as one of those 'guesses at the truth' which have so often preceded great discoveries." Downs[22] concluded in blunt words that "Nott tried to invoke transmission of some animalcule by some insect, but he was unsuccessful." Incisive and instructive are these analytical remarks by Wilson:[23]

> A careful review of Nott's writings ... seems to make it clear that the modern conception of the transmission of yellow fever and of malarial fever had not occurred to him at all. Indeed, he expressed the opinion very definitely that these diseases were not transmitted from the infected to the uninfected, but in each instance resulted from the invasion of the body from without, through unknown means, by some animal organism. The whole purpose of his argument was to point out that the analogy between certain known phenomena of insect life and the epidemiology of yellow fever gave support to the hypothesis of animalcular origin, it was not to suggest the mode of transmission. He uses the expressions "insect theory" and "animalcular hypothesis" interchangeably, and it seems evident that insects, infusoria and animalcules are terms which are also used interchangeably to embrace the lower forms of animal life. He argues that the causative factor of yellow fever must be one of these lower forms for the disease behaves as it would behave if this were the case. In this conception of its etiology he was a precursor of Laveran not of Walter Read [*sic*].[24]

Riley and Johannsen[25] obviously agree with Wilson about Nott's contributions:

> ... in 1848, Dr. Josiah Nott, of Mobile, Alabama, published a remarkable article on the cause of yellow fever, in which he presented "reasons for supposing its specific cause to exist in some form of insect life." As a matter of fact, the bearing of Nott's work on present-day ideas of the insect transmission of disease has been very curiously overrated. The common interpretation of his theory has been deduced from a few isolated sentences, but his argument appears quite different when the entire article is studied. It must be remembered that he wrote at a period before the epoch-making discoveries of Pasteur and before the recognition of microganisms as factors in the cause of disease. His article is a masterly refutation of the theory of "malarial" origin of "all the fevers of hot climates," but he uses the term insect as applicable to the lower forms of life, and the specific references to aphids, cotton worms, and others are merely in the way of similes... . Nott's ideas regarding the relation of insects to yellow fever were vague and indefinite ...

Finally, in the introduction to his classical work on malaria in the Mississippi Valley, Ackerknecht[26] deplores the creation of a widespread "Nott-myth": "Nott ... who ascribed malaria and yellow fever to the action of microscopic "insects", is credited with the promulgation of the hypothesis that mosquitoes transmit such disease-producing agents, a hypothesis of an absolutely different character and of which he did not think."

These analyses of the weakness of Nott's "thesis" accord with my own. It appears, furthermore, that Nott's papers, rather than serving as a practical legacy, were ignored or overlooked by later workers studying arthropods and disease. Insofar as I can determine, Nott's thinking did not influence Manson, King, Finlay, Smith, or Reed; Ross mentioned Nott

only in retrospect, and Osler not at all.

In a little-known but extensive document of 1871, Nott,[18] in the role of consultant, reported to New York City's Board of Health on the epidemic of yellow fever that had struck Governor's Island (in the city's bay) during the summer of 1870; of 774 residents, 159 fell ill and 52 died, but the fever did not reach the city proper. Nott's report of the epidemic occupies a negligible part of the 50-page paper, the bulk of which recapitulates his views about yellow fever, frequently in language borrowed wholesale from his earlier papers. Insects receive only passing attention and vague allusion as exemplified by this passage: "... it is the business of some insects to distribute certain seeds....to carry pollen... and it may be the duty of others to disseminate diseases." A later author quoted Nott's report and published this utterly indefensible remark (Augustin, 1909):[27] "If Dr. Nott had simply gone a little further and directly accused the mosquito of being the active agent of transmission, yellow fever would have been eradicated from the American Continent years ago and the illustrious Southerner would have occupied a place in the annals of fame which would have endured for all time to come." Augustin wrote this knowing the essentials of the insect transmission of malaria, filariasis, yellow fever, etc. Nott, by contrast, evolved his notions about insects in 1848, when even the causation of infectious disease was a mystery, and he died in 1873—five years before Manson's key work and decades before experiments finally incriminated hematophagous insects in the transmission of yellow fever and other diseases.

The best self-summary of Nott's views is provided in the resume of his 1871 magnum opus,[18] here reproduced in its entirety.[28] Note especially item four and the absence of any reference to insects.

> *First.*- Yellow fever, unless there be two distinct types of the disease, is not produced by marsh effluvia, or decomposing animal or vegetable matter. *Second.*- It springs from a living germ that has the power of self-propagation. *Third.*- The germ is not reproduced in the human system, and the disease therefore is not contagious. *Fourth.*- The germ is portable by vessels, baggage cars of railroads, in trunks, boxes, etc., and possibly in exceptional cases about the persons of individuals. *Fifth.*- The contradictory facts would seem to point to two distinct forms of yellow fever, one portable, the other not portable. *Sixth.*- Yellow fever (more particularly in northern towns) usually commences in one or two limited points, near shipping, from which it spreads in the most gradual manner for a month or six weeks. *Seventh.*- The disease is not influenced by winds in its rate of progress—is not conveyed to other parts of the town to which cases are taken; but extends by epidemic force, or its inherent mode of progression. *Eighth.*- In the yellow-fever zone the occurrence of the disease has no

appreciable connection with meteorological conditions of the atmosphere. *Ninth*.- In northern towns elevated temperature (beyond the usual mean) is favorable to its outbreak and propagation; but the presence of an imported germ, or descendant of an imported germ, is necessary to its origin. *Tenth*.- Yellow fever commences in an epidemic wave in the Gulf of Mexico, and the distance to which it extends northwards depends upon the force of the wave. *Eleventh*.- These waves come at irregular intervals, and are characterized by periods of activity followed by periods of repose of very variable duration. *Twelfth*.- Quarantine, or sanitary measures, have no power to arrest an epidemic wave. *Thirteenth*.- The epidemic wave rarely extends as far as New York, and quarantine may, by forbidding the entrance of vessels freighted with the *materies morbi* into our harbor, prevent the outbreak and spread of the disease in the city. *Fourteenth*.- To guard against dishonest violations of quarantine, it might be proper, if possible, to subject every vessel in the yellow-fever season, coming from the yellow-fever zone, to the influence of a temperature of at least 200°— or a temperature below 32°—both of which are effectual disinfectants. *Fifteenth*.- Yellow fever after prevailing in one part of a town may hibernate and resume its work in the remainder of the town the following summer. In like manner it will hibernate during its extended migrations from State to State, and continue its interrupted march in summer, for a series of years, as did the Rio de Janeiro epidemic in 1850 to 1855, terminating in Norfolk. *Sixteenth*.- Epidemic waves pay no respect to topography; they invade equally the moist low lands and the rocky, sandy, hill tops—the clean, healthy villages equally with the dirty alleys of cities—the palace and the hovel.

Nott was a well-known and respected physician, surgeon, gynecologist, anatomist, and medical educator, and is a still-controversial ethnologist. While his niche in Southern medicine is secure, his efforts to discover the secrets of yellow fever transmission fell short. If his grasp failed, however, no one can doubt that his reach was longer than that of any of his antebellum contemporaries.

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Emory University School of Medicine, Atlanta, for their courtesy and help, and Mrs. C. A. D. Hesterman, Academy of Natural Sciences, Philadelphia, for key reference material.

NOTES AND REFERENCES

1. Josiah Nott (1804-1873) was born and bred in South Carolina, studied medicine at the University of Pennsylvania and in Paris, and settled in Mobile, Alabama, where he practiced medicine and surgery. (According to a persistent, plausible, but undocumented Mobilian legend, Nott is said to have been the physician who delivered William Crawford Gorgas in 1854 in Mobile. True or not, it is a good story, joining in a unique way two familiar figures in the history of yellow fever.) In 1858 Nott founded the Medical College of Alabama, which closed with the onset of the Civil War; the college's lineal successor is the School of Medicine, University of Alabama, Birmingham, Alabama. Nott served with the Confederate forces, and later practiced gynecological surgery in Baltimore and New York before returning to Mobile, where he died of tuberculosis.

   Details of Nott's life are given by Anderson[29], Holt[30], Carmichael[31], and Bean.[32] Nott's researches covered many fields, including the arguable aspects of his ethnology, and Carmichael credits him with 68 papers; Carmichael's list, however, overlooks at least four publications. A book-length biography of Nott, as yet unpublished, has been prepared by Dr. John M. Shackleford,[33] College of Medicine, University of South Alabama, Mobile, Alabama.
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14. All italics in this and subsequent quotations from Nott are in the original papers.
15. For a review of ancient and modern beliefs on the association between insects and disease, see Service.[11]
16. Sir Henry Holland (1788-1873), physician to British royalty, traveller, and writer. Nott was doubtless referring to chapter 34 in Holland's book *Medical Notes and Reflections*, 1st ed. Philadelphia, Haswell, Barrington, and Haswell, 1839, 383 pp. The original chapter heading ends with a question mark "... expressing what is merely a speculation ... ."

17. The Infusoria loom large in Nott's speculations. The original taxon included an assemblage of diverse organisms that appeared in aqueous infusions of mud, hay, etc. The organisms were typically small, many microscopic, and included spirilla, protozoa, small insects and larvae, free-living nematodes, etc., a veritable catchbag of unrelated forms. The taxon has long since been split, and the name (until comparatively recent years used for the ciliated protozoa) is no longer used.
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